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9-1-2020

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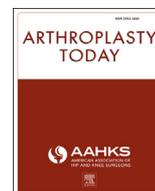
North T, Bullock MW, Danoff JR, Saxena A, Fischer SJ, Stronach BM, Levine BR. Arthroplasty during the COVID-19 Pandemic. *Arthroplast Today* 2020; 6(3):427-430.

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## White Paper

## Arthroplasty during the COVID-19 Pandemic

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## ARTICLE INFO

## Article history:

Received 24 April 2020

Received in revised form

30 April 2020

Accepted 5 May 2020

Available online 19 May 2020

## Keywords:

SARS-CoV-2

COVID-19

## ABSTRACT

This article aims to give a brief outline of the pathogenesis and transmission of SARS-CoV-2 and how to safely navigate an arthroplasty practice during and after the pandemic.

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## Introduction

The coronavirus disease (COVID-19) caused by the SARS coronavirus 2 (SARS-CoV-2) has brought professional life to a standstill for many orthopaedic surgeons around the world. Although some will be given roles to work on the front lines or take on leadership positions during this crisis, many surgeons will act in a supportive or reserve role. This article aims to give a brief outline of the pathogenesis and transmission of SARS-CoV-2 and how to safely navigate your practice during and after the pandemic. We will outline recommendations of how to resume clinical operations when restrictions are lifted.

## Presentation and incubation

As of writing of this article, there are over 3 million COVID-19–positive cases globally with over 215,000 deaths; however, the true number of cases has been and will continue to be difficult to ascertain because of the varying nature of how the viral illness

presents [1]. Early presenting symptoms of the virus frequently include fever, nonproductive cough, and fatigue, and occasionally gastrointestinal symptoms and anosmia [2–4]. A well-characterized subset of the population contracts the infection with indiscernible symptoms. The average incubation period has been reported to last 14 days, with a median presentation of 5 days [5,6]. There have been some reports of patients remaining infectious for over 20 days from the symptom onset [5]. Without widespread testing, quantification of this asymptomatic group in the pandemic is nearly impossible to determine [6].

## Basic pathogenesis

Infection begins when the virus binds to target human epithelial cells through the intermediary enzyme angiotensin-converting enzyme 2 [7]. It is believed that the upregulation of angiotensin-converting enzyme 2 during infection combined with angiotensin-converting enzyme inhibitors, angiotensin receptor blockers, nonsteroidal anti-inflammatory drugs, or thiazolidinediones can potentially predispose patients to a myriad of complications, including cardiac arrest, impaired ventilation, and death [7]. In addition, current research has found increased mortality in patients with multiple comorbidities including older age, obesity,

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existing pulmonary diagnoses, and diabetes [6–8]. In addition, hypertension may also be associated with an increased risk of both contracting symptomatic COVID-19 and hospitalization [7]. Currently, patients contracting the virus have a mortality rate between 4% and 7%, which is nearly 4 times that of the influenza virus [2,4]. This close-contact disease is spread via respiratory droplets that can enter the respiratory tract via mucosae or conjunctiva [8,9]. Transmission can also occur through fomites within the immediate environment of an infected person [8].

### Therapies

At this time, there is no proven or accepted treatment for patients with COVID-19. Current management strategies for ~80% of cases include symptomatic treatment focused on hydration and fever control (antipyretics) [2]. Intensive care monitoring and ventilator support are reserved for severe cases. The current trend is to review the efficacy of available therapeutic drugs in hopes of improving outcomes for patients with COVID-19. Multiple agents are currently being investigated, but none presently have yet been shown to offer a reliable benefit for patients.

Premature studies have suggested hydroxychloroquine, best known for its role in malaria prophylaxis and rheumatoid arthritis maintenance therapy, and remdesivir, an antiviral that gained popularity during the Ebola epidemic, could be effective in managing COVID-19 [10–12]. While no current randomized controlled trials exist, both medications are currently being investigated in several large clinical trials. Meanwhile, plasma infusion therapy using the separated blood products containing antibodies against COVID-19 from patients who have recovered is a strategy reserved for the most serious of cases [13]. Several vaccine trials are on the horizon with hopes of mass production within the next 12–18 months to promote long-term immunity, but further research is still required.

### Office practice

Surgeons may selectively evaluate patients in the office during the pandemic. New patients and follow-ups are being asked to reschedule to help limit exposure. Most offices see only patients with time-sensitive conditions including new fractures, suspected infection, or neurovascular compromise [14]. All patients should be screened before entering the office for fever, chills, or cough. If positive, they should be issued a mask and sent directly for evaluation per local protocol. The Centers for Disease Control and Prevention (CDC) currently recommends all individuals wear a simple mask when in public and to limit touching their face to prevent viral transmission [13]. The mask should cover the nose and mouth to prevent a contagion from infecting others with a compromised immune system. The CDC currently recommends an N95 mask be used for known COVID-19–positive patients [3,13]. Social distancing, which is currently defined as maintaining a distance of 6 feet from others, should continue among staff and patients. Rearranging waiting room seats, limiting the number of patients, coordinating radiograph time slots, and terminal cleaning of all essential equipment are required to comply with social distancing regulations set forth by the CDC to help prevent the spread of the virus [13].

Personal protective equipment (PPE) supply and stewardship will be important for the foreseeable future as reserves will likely remain low for some time in some areas. The proper removal and disposal of PPE should be reviewed to prevent inadvertent contamination [13]. Local guidance for use of PPE should be followed. Routine virucidal decontamination of reusable medical equipment/supplies should take place between each patient use.

As restrictions are gradually lifted, strict hand hygiene and social distancing will remain important in the office and community. The CDC recommends washing hands with soap and water whenever possible, and if unavailable, then using a hand sanitizer with at least 60% alcohol is encouraged [13,15]. A list of the CDC-approved sanitizers can be found on CDC's website [15].

### Staffing

Orthopaedic practices will need to prepare for potential exposure of a staff member or colleague. When symptoms consistent with COVID-19 infection are suspected or testing is positive for the virus, the individual should be sent home immediately and plan to quarantine until symptoms resolve [3,13]. Hospital infectious disease specialists have outlined viral testing protocols that can vary among facilities; therefore, we encourage surgeons to check with their affiliated hospital. Current return-to-work standards as outlined by the CDC include [13] the following:

1. Absence of fever without the use of antipyretic medications.
2. No dyspnea at rest.
3. Two independent, negative COVID-19 assays at least 24 hours apart.

As a prophylactic measure, staff members with risk factors for contracting the virus should be encouraged to work remotely from home if possible. The recommendations are frequently updated from the CDC [13].

### Integration of telemedicine

Virtual platforms offer an alternative to traditional in-office patient visits, given social distancing restrictions. In addition, these visits are billable encounters and represent an existing opportunity to maintain some degree of revenue-generating productivity. These include real-time audio-visual telemedicine visits, audio-alone telephone visits, and e-visits using patient portals. There are a number of regulatory and compliance matters specific to virtual health care at the federal and state levels, as well as payer-specific rules [16,17]. Providers should be familiar with these before initiating such modalities. Of note, there have been recent relaxations aimed at encouraging virtual health care at the federal level and state level and among payers. Many of these are temporary and tied to the pandemic, including those from the Department of Health and Human Services [16,18]. Given the evolving climate, offices should maintain a source document and log concerning compliance and remain vigilant for changes [16].

Codes for office telemedicine visits are 99201–99215 for new and established patients and require real-time audio and video [16]. Billing can be determined by medical decision-making (using 1995/1997 guidelines) or total provider time on the day of service, including preparation, and should append a 95 Modifier to comply with the recommended billing practices [16]. The Centers for Medicare and Medicaid services has also provided relaxed telemedicine regulations around a number of other visit types, including hospital-based and emergency department–based codes [16,17]. If your practice does not use a major third-party electronic health record (EHR) vendor with a Health Insurance Portability and Accountability Act–compliant option for video-based telemedicine, video-conferencing applications such as Facetime, Doxy.me, and Zoom are readily available. Enforcement discretion has been announced for Health Insurance Portability and Accountability Act compliance in connection with telehealth care during the COVID-19 emergency, but providers should avoid public-facing platforms such as Facebook Live. Providers are encouraged to monitor

ongoing regulation changes as conditions are expected to be re-evaluated soon [16].

Telemedicine visits can be completed via the smartphone, tablet, or computer. Audio-only visits for those patients who are unable to access audiovisual platforms are an acceptable form, and some payers allow for use of 99201-99215; however, Medicare will not [16]. Appropriate evaluation/management codes for audio-only visits are 99441-99443 and depending on the amount of time spent on the telehealth consult with the patient [16,17]. Relative value unit values for these codes are less than the telemedicine codes. Appropriate patient evaluation, documentation, and coding of these telemedicine visits can be reviewed in the American Association of Hip and Knee Surgeons Webinar—Telemedicine and Total Joint Surgeons: How to Run a Virtual Practice (<https://aahkszoom.s3.amazonaws.com/Telemedicine/webinar-telemedicine-04142020.mp4>).

### Operative cases

Elective arthroplasty cases have been postponed at most hospitals around the country; however, many surgeons continue to contribute through on-call responsibilities and addressing time-sensitive urgent and emergent cases [14]. The operating room can be a high-risk environment during the current pandemic, particularly if intubation is required, as the virus can become aerosolized. Most of these recommendations have been learned from prior experience with aerosolization of SARS-CoV-2 [2,4,5]. The COVID virus has not been isolated in the bone or marrow, which is particularly relevant to orthopaedic surgeons using high-speed burs and saws [12,19]. To further protect trainees, the Accreditation Council for Graduate Medical Education has recommended medical students, residents, fellows, and other support staff members should only be used in the operating room if absolutely necessary to prevent viral exposure [20].

All team members should don an approved gown, gloves, eye protection, and an N95 mask before contact with an active COVID-19 patient [19]. It is currently recommended that only essential members of the anesthesia team are present in the operating suite at the time of intubation. To prevent potential exposure, the surgical team should enter the operative suite only after the airway is secured and an allotted amount of time to allow air exchange within the operative environment. Most air-handling systems can exchange the air in 15 minutes, but this should be confirmed with your hospital's engineering department [21]. Surgeons should consult their anesthesia colleagues in regard to general or regional anesthesia for infected patients.

It is important to remain vigilant during this time of increased infectivity, especially in high-risk environments such as the operating room and intensive care unit (ICU). According to manufacturers, orthopaedic surgical hoods alone are not protective against this virus [13,19]. All surgeons and operative staff members should maintain universal precautions at all times and use N95 masks when operating on COVID-19-suspected or COVID-19-confirmed patients [3,13,20]. Covering the N95 with a level 1 approved mask may help to prevent soilage, which then requires mask disposal [13,19]. Otherwise, the N95 mask can be decontaminated by a variety of methods and then reused.

As mentioned previously, there are subsets of population that have increased risk of morbidity and mortality with COVID-19 disease [2-6]. Patients who undergo surgery during active infection or become infected shortly after surgery are another identified high-risk population [4,22]. A recent retrospective cohort study from China summarized their early operative outcomes on this population [22]. Their findings are consistent with current thoughts, suggesting that older individuals with multiple comorbidities are at

higher risk of complications. Surgery on these patients, such as a high-energy trauma patient, seems to initiate a “second-hit” phenomenon that can induce a systemic inflammatory response. Operating on a patient with COVID-19 can have grave consequences, with nearly 44% requiring ICU care after surgery and a mortality rate up to 20% [22]. As surgeons, we will need to maintain open communication between the other members of the medical team to provide coordinated care for our patients. The ability to consistently and promptly identify SARS-CoV-2 carriers will further help to navigate this pandemic. Routine serologic testing for SARS-CoV-2 for all patients, and in some circumstances, health-care staff members, is being considered by public health officials.

### A return to normal

A timeframe for a normal elective arthroplasty schedule is still being debated. Initially, there will need to be a balance between surgical volume to address case backlogs and ensuring orchestration of appropriate hospital support for patients regarding staff and supplies. In addition, availability of the operating room PPE and a reliable central processing system are keys to operative consistency. Regular open communication with immediate team members, nursing managers, and hospital administrators will facilitate a safe return to elective cases.

The surgeon also needs to facilitate discussions between device manufacturers and hospitals to ensure essential equipment is available. This is of particular importance because many supply chains have been disrupted; implant companies may need additional time to ensure equipment and implants are readily available. During the early return to elective cases, surgeons must remain flexible with operative schedules, knowing that case mix may vary for an extended period of time in comparison with previous practice routine.

Social distancing practices will likely persist for quite some time after elective cases resume. Patient social support systems will be impacted as we expect most facilities will limit visitors at office encounters and around the perioperative period for an undetermined period of time as we continue to navigate the viral pandemic. Surgeons should be prepared for the possibility that a patient's family member or support person may not be allowed to enter the facility and their comfort level without a “coach” may lead to delay or cancellation of the surgery. These considerations will likely impact the surgeon's normal schedule. Reopening schedules for elective cases will likely include some additional challenges.

Concurrently, multiple outpatient therapy clinics, considered essential businesses, remain open to provide rehabilitation services during the pandemic [23]. The opportunities for manual interventions will be limited; therefore, the therapist will consider transitioning to a coach/instructor over therapy-specific telehealth venues (ie, Force Therapeutics, VERA by Reflection Health, and Virtual Physical Therapy) to continue to assess range-of-motion and regain function during this period [23].

Operating room efficiency will most likely be affected because of room turnover precautions. This is in part due to the extra time required for cleaning and preparation protocols including proper room sterilization procedures, air filtering protocols after intubation, and limited availability of support personnel. Furthermore, the patient volume and postanesthesia care unit throughput will also be a hindrance as the ramp-up initiates.

At the start, joint replacement surgeons may want to focus on routine primary cases and gradually introduce more complex cases over the next several months. Some entities have suggested that high-volume revision cases may place undue strain on PPE supplies, operating equipment sterilization, and staff social distancing practices. Complex cases will likely require lengthy hospital stays, which increases the risk of patient exposure to the virus [23]. In addition,

larger cases carry a higher likelihood of ICU admission in a time when acute care beds and ventilators are in short supply. Surgeons are advised to check with their individual hospitals for guidance on these issues.

Finally, procedures and regulations will vary across different regions of the country and community settings. Areas with lower viral density are more likely to see a faster “return to normal” than harder hit regions. By the same token, hospitals and surgery centers in smaller cities that are more remote from larger urban areas may be faster to ramp up their elective schedules.

An evolution in health care is on us as we learn to navigate this pandemic. Expect the time to resume normal schedules and procedures to be gradual over the next several months. Advances in telecommunication enable surgeons and therapists an avenue to provide individualized patient care from a safe distance. Above all, communication remains essential to meet patient needs and expectations. If a patient requires a face-to-face encounter, appropriate precautions have been outlined to ensure the office visit is safe for all parties involved. Because this respiratory disease is spread via droplet transmission, hand hygiene is the most critical step to slow the spread of the COVID-19 virus. Patience is paramount as we adapt our orthopaedic practices to safely meet the future needs of our patients.

### Conflict of interest

Brett. R. Levine, MD, MS currently serves as DePuty Editor for *Arthroplasty Today*. He has recused himself from the communication, editorial, and peer-review process for this submission. In addition, Jonathan. R. Danoff, MD and Matthew. W. Bullock, MD currently serve on the *Arthroplasty Today* editorial board—they have also been excluded from the peer-review and editorial process for this manuscript.

### Acknowledgments

The authors would like to thank Denise Smith Rodd (Communications Department—American Association of Hip and Knee Surgeons) for her help collating and proofreading this manuscript.

Authors' contributions: All authors have contributed to the writing of this manuscript.

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